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ABSTRACT

This document is an instructional module package prepared in objective form for use by an instructor familiar with operation and maintenance of a trickling filter wastewater treatment system. Included are objectives, instructor guides, student handouts and transparency masters. This is the first level of a three module series and considers the purpose, use, components, operation and maintenance, and expected performance of a trickling filter system. (Author/RH)

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BASIC TRICKLING FILTERS

Training Module 2.110.2.77

Prepared for the

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September, 1977

SE 024 028

SUMMARY

Module Number 112 DWW	Module Title Basic Trickling Filters
Apx. Time 11 Hours	Submodule Titles: 1. Introduction to Biological Treatment 2. Overview Trickling Filters -Component Parts 3. The Purpose of the Trickling Filter 4. Normal O & M For A Filter 5. Safety in Trickling Filter Work 6. Field Visit to a Trickling Filter Plant, Including Checklist

Overall Objectives: Upon completion of this module, the trainee will be able to describe the reason for using, the use of, the components of, the normal O & M of, and the expected performance of the trickling filter concept of trickling filter operations in wastewater treatment.

Instructional Aids:
Overhead Transparencies
35 mm Slides With Key
Handouts
Diagrams
Check lists
Instructor Key Points

Instructor Approach:
Submodules 1-5 Lecture + Discussion
Submodule 6 Lecture (Brief)
plus Demonstration
plus Discussion

References:

1) WPCF - MOP 11, 1977. "Operation of Wastewater Treatment Plants".
2) WPCF - MOP 14, 1967. "Wastewater Treatment Plant Operator Training Course Two".
3) R. Layton. Personal Notes and Teaching Outlines, 1970-77.
4) R. Antonie, 1976. "Fixed Biological Surfaces-Wastewater Treatment".
5) NAVFAC, 1969. "NTTC Course 216, Intermediate Sewage".
6) EPA, 1970. "Operation of Wastewater Treatment Plants - A Field Study Training Program".

ADDITIONAL COMMENT

1) Instructor will follow detailed audio visual presentations and checklists - distributing material to trainee as indicated.

2) Instructor will evaluate trainee objectives accomplishment by (a) field trip assignment, and (b) 50 question examination (written) at end of the basic trickling filter module. All six of the sub-modules use the same type of instructional aids and instructional approach and references.

Module No. 112DWW	Module Title Basic Trickling Filter
2 Hours	Submodule Title: Introduction to Biological Treatment, Aerobic vs Anaerobic Processes.
Objectives:	The trainee will: 1) Describe the terminology and objectives of trickling filter operations. 2) Identify aerobic vs anaerobic systems and the necessary relationships of each. 3) Recognize the need for adequate pre and primary treatment before trickling filter operations. 4) Discuss personal experiences (if any) with trickling filter operations.

BASIC TRICKLING FILTER - 112DWW MODULE
Instructor Lesson Guide
Hours 1 & 2 of 11

Overhead Slide #	Slide Description	Instructor Key Points
1	Primary treatment Secondary treatment Tertiary treatment	Review of previous lesson terminology
2	Types of solids in "typical wastewater"	(1) Review of previous lesson terminology (2) Review calculation of mg/l or ppm to %. Stress use of mg/l
3	Trickling filter is biological treatment, secondary treatment Convert suspended, non-settleable and dissolved solids to settleable solids.	Definition of terms and trickling filter function
4	Trickling filter solids called "humus" or secondary sludge must use secondary clarifier with trickling filter	(1) Terms (2) Evaluate T.F. only <u>after</u> solids removal
5	Aerobic process food bugs oxygen	First ask class for 3 items needed in biological treatment
6	Aerobic System Description	(1) Trickling filter uses this process (2) Food-BOD/N/P concept (3) Oxygen for respiration (4) Types of "Bugs" (5) "Stable" sludge no nuisance or oxygen demand (6) Products of respiration and assimilation - no odors, eutrophication occurs - explain why

7	Anaerobic Process (no free oxygen) (septic)	(1) Too much food (2) Too little oxygen (3) Bugs-different from aerobic (touch upon facultative) (4) Odors, nuisance, unstable sludge (5) Occurs in T.F. operation-clogged vents, incorrect loadings, toxic loads
8	Trickling filter needs: Food-BOD/N/P 100/2/1 Ratio!	(1) Compare to trainee breakfast-BOD gives energy & new growth nitrogen gives amino acids and proteins-phosphorous is energy source (2) Trickling filter won't work without this minimum ratio.
9	Oxygen (air=20%O_2)	(1) Vent systems give oxygen, draft effect-filter must not be septic (2) No oxygen-"bugs" die
10	"Bugs" (1) Aerobic, facultative bacteria eat solids (2) Algae (green or surface) (3) Fungi-favored if low DO and low pH (4) Protozoans-eat bacteria (5) Nematodes (6) Snails-eat slime (7) Fly (psychoda, others)	(1) Chief workhorse-refer to slide 6 (2) Indicator of "shock loads" (3) Often indicates septic conditions have or will occur soon (4) Help with coliform count (5) Sensitive indicator of shock conditions (6) Often cause stoppages problem (7) Nuisance-no real health hazard (8) Zoogleal film- bugs slime layer (9) Discussion in depth can be accomplished if trainee need dictates. expansion of

11	Pretreatment and Primary Treatment-keys to Trickling filter performance	(1) Stress need for sewer use ordinance (refer to WPCF MOP3 or EPA course 179.2) (2) Review sewer use ordinance guidelines established for state. (3) Key Point - "Every-thing effects everything"
12	You should know: (1) Types of treatment primary, secondary, tertiary (2) Solids in wastewater (3) Purpose of trickling filter (4) Importance of secondary clarifier (5) Three items for aerobic process: food, bugs, oxygen	(1) Instructor review key lesson points (2) Summary aprox. 15 minutes, slides 12
13	You also should know: (1) Aerobic sewage treatment process (2) Anaerobic sewage treatment process (3) Trickling filter needs: BOD/N/P 100/2/1	(1) Ask for other examples-activated sludge, lagoon, etc. (2) Ask for examples-Imhoff tank, anaerobic lagoon, septic tank (3) Ask why? Resummarize slide 8 if needed
14	Also that food, oxygen and "bugs" effect performance	(1) Lead short discussion (5 minutes) on problems experienced by group in this area. For example, vents broken, snail problems, super cooling, or others.
15	Sewer use ordinance	(1) Lead discussion concerning problems experienced by group (if any with non-compliance) with sewer use ordinance.
16	Questions!	(1) Emphasize-only poor question is the one you don't ask (est. 5 min)

END

Module No. 112DWW Hours 3 & 4	Basic Trickling Filter
2 Hours	Submodule Title: Overview of a Trickling Filter - The Component Parts.
Objectives	The trainee will: 1) Identify and list the four component parts of a trickling filter. 2) Discuss and list the functions of the component parts. 3) List the BOD/N/P concept and its importance in trickling filter operations. 4) Identify a "typical" or normal trickling filter plant flow diagram. 5) Identify the component parts of a trickling filter.

BASIC TRICKLING FILTER - 112DWW MODULE
Instructor Lesson Guide
Hours 3 & 4 of 11

Overhead Slide #	Slide Description	Instructor Key Points
2-1	The Four Component Parts of a trickling filter are: Underdrain Media Distributor Retaining Wall	Ask class to write them down before you show slide.
2-2	What Does Each Part Do? 1) Underdrain System	1) Allows collection of treated wastewater. 2) Allows air (oxygen) through filter. 3) Stress aerobic.
2-3	Types of Underdrain System Blocks	Design discussed later
2-4	How about the media? What types are used?	Simply show slide and ask trainee to write answer.
2-5	Types of Media: Stone Brick Redwood Plastic Coconut Shells Other	1) Ask question - why can these various materials be used? (answer: only surface used) 2) Design covered later
2-6	Distributor Arm and influent structure components: Influent pipe Distributor base Arms Splash plates Arm cleanout Level adjustment Turn buckles	Review list from slide

2-7	Retaining wall and vent ports	List-ask question- why use a retaining wall? - cold weather and other.
2-8	Trickling filter with 4 parts illustrated	1) Courtesy EPA-Kerri manual. 2) Discuss 4 component parts - good construction necessary, good operation critical.
2-9	What are the four components of the trickling filter? List them	Review 4 parts
2-10	What are we trying to accomplish with these four components	Read slide and stimulate answer
2-11	Convert dissolved and colloidal solids to settleable solids.	1) Slide 2) Let's look inside the filter bed.
2-12	Biological Action on a trickling filter	1) Explain trickling filter not filtration 2) Respiration process- bacteria breathe oxygen and give off carbon dioxide. 3) Biological oxidation by "zoogleal" film-same as aerobic treatment. Slide (use of needed) 4) "Sloughing off" gives trickling filter humus or secondary sludge
2-13	Trickling Filter needs food (sewage) oxygen (air) "Bugs"	Relate this to human needs - trickling filter is the home.

2-14	Typical Sewage Description	1) Emphasize food 2) Illustrate BOD/N/P Ratio of 100/2/1 3) Stress toxic or shock loads in filter. 4) Equal distribution by rotary distributor and clean orfices. Idea is to provide food in optimum fashion.
2-15	Oxygen and vent system	1) Emphasize aerobic nature of filter 2) Temperature differential of 4 deg.F for air movement. 3) Vents must not be broken, etc. 4) Leaves, stoppages, ponding, etc covered later.
2-16	"Bugs"	1) All types in sewage, many of them-downplay "enzymes". 2) Toxic effects of sewer use ordinance should be stressed
2-17	Typical Trickling Filter Plant flow diagram	Stress: 1) Sewer use ordinance 2) Pre & primary treatment must be adequate-"everything effects everything" 3) Primary sludge removal & scum removal - a must-carryover gives clogged orfices & filters, septic sludge or wastewater, not compatible with filter operation. 4) Stress components of trickling filter 5) Mention recirculation (high rate filters) 6) Secondary settling tank use as a necessary part of the system 7) Touch on sludge disposal problems with humus

2-18	Questions	Approximately 10 minutes for answering questions

Part 2
Apx. 25 minutes

Slide #	Illustrates	Instructor Key Points
1	Influent Area -Red Color	Pretreatment and Sewer Use Ordinance Important
2	General View - Well Maintained	Point out 4 Compounds of Trickling Filter
3	Underdrain - Vents	Aerobic Conditions
4	Underdrain - Openings To Inspect	Safety
5	Inside Trickling Filter	Safety - Fines
6	Media - Stone	Size, Color, Odors, Problems
7	Media - Plastic	
8	Distributor Arms	Stress Influent, Seals, Arms, Splash Plates, Arm Cleanout, Level Adjustment
9	Distributor Orfices and Splash Plates	
10	Retaining Wall	Odors, Fly Problems, Mosquitos, Freezing Problems
11	Dosing Tank	Leaves, Grease
12	Recirculation Pumps	Normal O&M of Pumps
13	Overview of Series Operation of Trickling Filter	Answer Questions

END

Module No. 112DWW Hour 5	Basic Trickling Filter
1 Hour	Submodule Title: Purpose of the Trickling Filter
Objectives	The trainee will: 1) List the 3 necessary items in trickling filter operations and the factors influencing them. 2) Identify normal vs abnormal trickling filter performance. 3) Calculate a % removal for a trickling filter. 4) Identify normal values for trickling filter performance.

BASIC TRICKLING FILTER - 112DWW MODULE
Instructor Lesson Guide
The Purpose of the Trickling Filter
Hour 5 of 11

Overhead Slide #	Slide Description	Instructor Key Points
3-1	Object of Trickling Filter to Convert Suspended (NON-Settleable) and Dissolved Solids to Trickling Filter Humus (Settleable Solids) Called Secondary Sludge	1) Review & Reemphasize Biological Process
3-2	Remember: Food Oxygen Bugs	1) BOD/N/P Ratio 2) Toxics & Sewer Use Ordinance 3) Pre & Primary Treatment
3-3	Also Aerobic Process - Effluent Saturated With D.O.	1) Review "Aerobic" 2) Define Effluent 3) Define Saturated 4) Define D.O.
3-4	Temperature vs Saturation of D.O. Values	1) Explain Graph, show how to Read Results 2) Have Trainee Read Two Values For Two Temperatures 3) Explain Correction for Altitude and Lower D.O. Values 4) Explain Correction for Salt Water (High Ion Concentration) Correction vs D.O. Values 5) Apply 3 & 4 to Mountain and Coastal Treatment Plants
3-5	What Would The Expected Oxygen (D.O.) Level Be For A Normal Trickling Filter Operation (Effluent)	1) Review
3-6	Right! Saturation Value	1) Review

3-7	What Factors Effect Saturation?	1) Review
3-8	Right! 1) Temperature 2) Altitude 3) Salt Concentration	1) Review and Reemphasize
3-9	What Other Two Things Were Needed For Normal Filter Operation?	1) Slide, ask Question
3-10	Right! Food (Sewage) and Bugs	1) Review
3-11	How About The Food? BOD/N/P 100/2/1	1) Review
3-12	BOD Means- Biochemical Oxygen Demand - 5 Days at 20° C, Normal Values- Raw Sewage 204 mg/l Trickling Filter Effluent 30-40 mg/l	1) Review BOD Concept 2) Review "Standard Values" 3) Show That .17 Pounds of of BOD_5/person/day and 100 gpcd Sewage Gives 204 mg/l 4) Stress: Sewage is Food!
3-13	Trickling Filter Plant (Primary Units Plus Trickling Filter plus Secondary Clarifier) Influent 204 mg/l Effluent 30 mg/l Removal was: 204 - 30 = 174 mg/l BOD (Removed as Sludges)	1) Review Primary if Needed 2) Stress Trickling Filter Must Be Evaluated After Secondary Clarifier 3) Biological Oxidation Process Gave Removal 4) Removal is In-Out

3-14	How Efficient Is This Filter In BOD (Food) Removal?	1) Ask Question
3-15	Right! 87% OR $\frac{\text{In-Out}}{\text{In}} \times 100 = \%$ Removal OR $\frac{204 - 30}{204} \times 100 = 87\%$	1) Stepwise - Calculate % (87) 2) DO additional - Example: 204 mg/l 35% Removal of BOD in Primary Find Effluent BOD (Answer - 133 mg/l)
3-16	Nitrogen Cycle Chart	1) Review What Is Happening In Oxidation From Ammonia (Actually NH_4^+) To Nitrite (NO_2^-) to Nitrate (NO_3^-)
3-17	What Should The Trickling Filter Effluent Contain? Ammonia or Nitrite or Nitrate	1) Again, Question, then Relate to "Oxidation" $NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$
3-18	Right! Nitrate or NO_3^-	1) Answer Questions on Nitrogen Oxidation 2) Nitrate Levels Vs Nitrite Levels Indicates Degree of Oxidation and Need for More Recirculation (discussed later)
3-19	High Nitrates (Effluent) Indicate Good Performance	1) Discuss Testing for Nitrates and $NH_3/NO_2^-/NO_3^-$ Ratio as Indicator of Normal and Expected Filter Performance
3-20	Phosphates - High Level Also $PO_4^{\equiv}$	1) Indicate Phosphates Used As Catalyst 2) Usually High In Effluent As $PO_4^{\equiv}$

3-21	Summary Purposes of Trickling Filter 1) Solids conversion - Removal 2) Saturated Dissolved Oxygen 3) BOD Removal 4) Oxidation of Nitrogen 5) Phosphates In Effluent	Summary and Review of Key Topics
3-22	Questions	Encourage trainee questions (allow aprox. 5 minutes)

END

Module No. 112 DWW Hours 6 & 7	Basic Trickling Filter
2 Hours	Submodule title Normal O & M for Trickling Filters
Objectives	The trainee will: 1) Identify the 10 areas of trickling filter O & M and factors affecting each. 2) Identify parallel vs series operational modes for a trickling filter

BASIC TRICKLING FILTER - 112DWW MODULE
Instructor Lesson Guide
Trickling Filter O & M
Hours 6 & 7 of 11

Overhead Slide #	Slide Description	Instructor Key Points
4-1	Trickling Filter O & M	Title Slide
4-2	Areas of Trickling Filter O & M 1) Pretreatment 2) Primary Treatment 3) Grounds and Housekeeping 4) Trickling Filter Retaining Wall 5) Distributor Arms, Orfices, and Center Column 6) Media 7) Underdrain System 8) Dosing Tanks (where applicable) 9) Recirculation Pumps 10) Multi-Filter Operation	Word Slide To Introduce 10 Subject Areas - Each Will Use Question And Answer Technique
4-3	Why Consider Pretreatment As A Part of Trickling Filter O & M?	1) Ask Question - With Slide - Stimulate Trainee Response
4-4	Everything Effects Everything Sewer Use Ordinance High or Low pH | Kill "Bugs" High BOD/COD | Septic Filter Heavy Metals | Toxic Loads Grease | Coat Media Others	1) Word Slide - Use Table Stimulate Discussion of Need for Strict Sewer Use Ordinance Compliance 2) Ask for Examples By Trainees of Non-Compliance
4-5	Primary Treatment - Why Important to Trickling Filter Performance?	1) Ask Question - Word Slide 2) Stimulate Discussion
4-6	Poor Primary Effluent Septic (no DO) Effluent | Cause Filter To Decrease Removal Solids Carry Over (Sludge) | Clog Filter-Decrease Removal	1) Stress "Everything Effects Everything" 2) Must Have Good Primary Removal to Obtain Good Trickling Filter Performance

4-6 continued	Grease Carry Over Clog Filter Coat Stones	
4-7	What are Good Grounds and Housekeeping Practices?	1) Question/Discussion
4-8	Right! 1) Good Grass and Mowing Edge Work 2) No Vines or Weeds Near Filters (fly & mosquito problem) 3) Flowers (optional) Near Filters 4) No Trees Near Filter (leaf problems) 5) Sidewalks Clean, and Clear 6) Prevent Odor Problem	Review Word Slide and Stimulate Other Ideas
4-9	O & M on Retaining Walls?	Ask Question, Stimulate Answer
4-10	Retaining Wall O & M 1) Inspect for Cracks, Breaks Repair as Needed 2) Remove High Grass and Weeds Nearby 3) Remove and Prevent Organic Growth and Black Slime From Interior Wall (odors) 4) If Structure Painted or Coated, reapply as Needed 5) Other?	1) Word Slide, Review 2) Stimulate Discussion
4-11	O & M of Distributor Center Column, Arms, and Orfices. What To Do	Question/Discussion
4-12	Center Column O & M 1) Mechanical Seal - Inspect and Replace Following O & M Manual Guidelines 2) Inspect Oil Level For Bearings on Weekly Basis-Change, Following Manufacturers Specifications 3) No Mercury Seals!	Review Slide Then Show Slide 4-13 and Review Again

4-13 –	Slide of Mechanical Seal Instructor passes out manufacturers literature on mechanical seals.	1) Describe How Seal, Bearings, and Oil Function 2) Ask for And Answer Questions On
4-14	Distributor Arms O & M?	Question/Discussion
4-15	O & M Disbributor Arms 1) Inspect for Corrosion, Paint Failure, Rust 2) Adjust Level of Arms Using Surveying Techniques for Summer vs Winter Operation (Turn Buckles) 3) Flush Weekly - Rod If Necessary	1) Paint, Clean, Rework As Required 2) Indicate Arms Should Be Slightly Raised When Empty Because of Weight of Water
4-16	O & M Distributor Orfices O&M?	Question/Discussion
4-17	O & M Distributor Orfices 1) Keep Clean With Wire Brush-Daily if Needed - Remember Safety 2) Can Run "Pan Test" To See If Equal Flow Pattern Obtained 3) Cold Weather Adjustment To Prevent Freezing Decrease Spray Pattern 4) Inspect for Snail Problem	Word Slide 2) Place Pans On Filter Surface - Measure Water After Several Passes - See WPCF MOP 11 3) As Required 4) Discuss "Snails" and Problem Solving in Section 3
4-18	O & M for Media?	Question and Answer
4-19	<u>Trickling Filter Media O&M</u> Inspect Several Times Each Day for: Color-green, how much Odor - None Industrial Wastes	Comment on: 1)Color - Good Growth vs "Shock" Killed Filter Too much - Use HTH or Cl_2 2) Odor-Industrial Waste or Septic 3)Industrial Wastes 1&2 above

4-19 continued	Primary Treatment Solids Filter Fly Problems Filter Ponding (Pools Of Water) Black Slime in Voids Snail Problems Growth on Filter Stones (Use Glove) Biological Forms (Microscope)	4) Primary Treatment Essential 5) Discussed Under Fly Control-Section 3 6) Ponding - Discussed Under Troubleshooting 7) Black Slime Means Septic (Anaerobic) Filter 8) Snail-Under Trouble-shooting 9) Use Safety in Collection
4-20	Under Drain O & M What Should You Do?	Question/Discussion
4-21	Trickling Filter Underdrain and Vent O & M 1) Inspect Weekly: -Water Levels for Clogging -Look For Fine Solids From Filter Breakup -Snail Carcasses 2) Flush Out as Required 3) Control Snail Carcasses 4) Clean and Remove Stoppages 5) Safety Section Must Be Read First	1) Word Slide-Follow 2) Ask for Trainee Experience/Question
4-22	Trickling Filter Dosing Tanks O & M? Where Used?	Ask Question, Stimulate Discussion
4-23	Trickling Filter Dosing Tanks O & M 1) Used With "Older" Standard Rate Filter 2) Check for Leaves, Grease, or Other Stoppages 3) Check Vent-No Stoppage 4) No Solids or Odors Use Good Housekeeping	1) Briefly Describe Standard vs High Rate Filter-Complete Discussion - Section 2 2) Physically Remove Leaves (Cover If Required) 3) Grease Can Be Removed With Sodium Hydroxide (Caustic)
4-24	Dosing Siphon How it Works (Figure)	Discuss Siphon and How It

4-25	O & M of Recirculation Pumps 1) Normal Pump O & M Manufacturer Recommendations 2) Flow Equalization and No Flooding 3) Recirculation Rate vs BOD Loading	1) Discussed Later in Detail. 2) No Flooding Because Of Simultaneous Pump Operation 3) Discussed in Detail Later, but Introduce Concept of Higher BOD Means Higher Recirculation Rate
4-26	Multi-Filter O & M 1) Normal Filter O & M as Above 2) Parallel vs Series Operation 3) Flow Equalization	1) Review 9 Items Above 2) Cold Water and Ice Problems vs Series Operation 3) Time Filters - Equal Flow is Usually Equal Time Of Rotation (also do pan test item 4-17 (2))
4-27	O & M Reocrds Laboratory Control Safety Considerations	Word Slide
4-28	Questions?	Stimulate Discussion aprox. 5-10 Minutes and Answer Questions

END

Module No. 112 DWW Hour 8	Basic Trickling Filter
1 Hour	Submodule Title: Safety in the Trickling Filter Works
Objectives	The trainee will: 1) Identify the dangerous areas and accident causes in trickling filter operations. 2) List prevention procedures for these accident causes.

BASIC TRICKLING FILTER - 112DWW MODULE
Instructor Lesson Guide
Safety in Trickling Filter Operations
Hour 8 of 11

Overhead Slide #	Slide Description	Instructor Key Points
5-1	Safety in Trickling Filters	Title-Word Slide
5-2	Wastewater Operations - Very Dangerous. WPCF Statistics List Wastewater Operations Many Times More Dangerous Than Other Occupations	1) Instructor Should Stress The Actual Need for Safety Program- Accidents Happen When You Don't Expect Them 2) Safety is Real - It is Needed - It Is Deadly Serious.
5-3	Trickling Filter Accidents 1) Poor Housekeeping 2) Poor Personal hygene 3) Underdrain and Ventilation Work 4) Careless-Getting On Filters	Word Slide
5-4	Accidents and Poor Housekeeping Examples	Stimulate Trainee Response To Share Ideas
5-5	Poor Housekeeping 1) Grease on Walkways- Slips and Falls 2) Piles of Debris - Falls, Cuts, Nail in Foot 3) High Grass - Snakes, Odors Turned Ankles 4) Filter Vent Grates - Open or off - Falls	1) Stimulate Personal Experience of Recent Accidents In the Area 2) Stimulate Trainee Thoughts 3) Discuss Prevention of Each Of The Four Items
5-6	Accidents and Poor Personal Hygene, Examples?	Stimulate Trainee Input

5-7	Personal Hygene 1) Disease Transmission -Sample Collection -Picking Up Stones -Unclean Clothing -Cooking or Eating Near Plant -Biting Fingernails	1) Relate and Review Types Of Pathogenic Transmission- cholera typhoid infectious hepatitis many others 2) Stimulate Trainee Ideas On Prevention of These: gloves leaving clothes away from their children no eating in plant or trickling filter area
5-8	Underdrain and Ventilation Accidents. What Are They?	1) Ask trainees to answer word slide
5-9	Right! Suffocation and Explosion	1) Discuss Recent Occurances of Both These Types of Accidents 2) Stress that death or Disabling Accidents are Often Produced
5-10	Prevention of Suffocation: 1) Test for Oxygen Deficiency and Gases Such as Hydrogen Sulfide and Methane 2) Attach "Approved Safety Hardness" and Use Life Line Before Entering Vent Area 3) For Long Jobs- Repeat Gas Test Above (1) Or Use Scott Air Or Other Self Contained Units 4) Station 2 Men at Entrance To Vent System To Help With Life Line	1) Stress or Show How to Use Approved Gas Testing Indicators If Not Covered Elsewhere in Program Have Trainee Perform 2) Demonstrate With A Trainee and Have Each Trainee Perform the Task in the Classroom 3) Demonstrate and Have Trainee Put on and Use Available Equipment 4) Stress Details of Lesson Relate Recent Deaths That Have Occured

5-11	Prevention of Explosion 1) Test Area for Methane and Other Suspected Gases 2) Do Not Enter Unsafe Area 3) Use Safety Equipment On Last Slide 4) Avoid "Sparking" Tools-Lights, Torches, etc. 5) Wear Non-sparking (Static Electricity) Shoes - Rubber Preferred 6) Use Protective Gloves, Clothing, and EyeWear as Required 7) Use Forced Air Ventilation Where Required	1) Review Test Procedure If Required 2) Not Worth The Risk 3) Review Questions About 4) Relate Methane to Cooking Gas Explosion 5) Cite Recent Examples Of Accidents of This Type 6) Ask for Trainee Experience or Questions 7) Illustrate to Trainee This Type of Unit - If Available - If Not Covered In Detail in Field Inspection in Lesson 6
5-12	Carelessness 1) Open Vent Covers 2) Operator Walking or Running On Filter Surface 3) Horseplay 4) If Filter Valved Off or Stopped in Place - Tag and Lock (if possible) While Working On Filter - Pumps Included	1) Discuss Falls -Especially at Night 2) Slick and Dangerous Can't Stop Distributor 3) Never 4) Again Stress Hydraulic Force of Moving Filter Distributor 5) Stimulate Trainee Thoughts and Comments

5-13	Solutions to Trickling Filter Safety 1) Initiate Management Safety Program 2) Initiate Operator Safety Program 3) Follow Guidelines Above 4) OSHA	1) Covered Elsewhere In Training Course But Stress Management Is Key to Safety 2) Covered Elsewhere 3) Questions? 4) Review OSHA if Time Permits
5-14	Questions or Personal Observations?	Stimulate Trainee Discussion of Need For Safety and Trickling Filter Safety

END

Module No. 112 DWW Hours 9, 10, & 11	Basic Trickling Filter
3 Hours	Submodule Title: Field Visit to a Trickling Filter Plant, Including Checklist.
Objectives	The trainee will: 1) Identify and list various components, O & M procedures, and normal trickling filter performance by visiting an operational plant and completion of homework covering same. 2) Complete a 50 question, comprehensive written examination of Module 112DWW with a 70% or more correct score.

END

Field Visit to a Trickling Filter Plant
Hours 9, 10, 11 of 11

Performing the Field Visit (3 Hours) Lecture with Tour

OBJECTIVE: To present the potential trainee with a suggested procedure for reviewing performance in a trickling filter plant.

Overview of Instructor Preparation

PREWORK: The instructor should review the plant plans, NPDES forms, previous O & M reports and other information available to him regarding the plant prior to the visit. If the instructor is a licensed plant operator, it will be of assistance. (See checklist before leaving the plant.)

STEP 1
Instructor Office Work - Pre-Study

BEFORE LEAVING FOR THE PLANT VISIT

Items to Check	Suggested Sources of Information	Remarks or Actions That May Be Needed
A. Your own technical ability regarding trickling filter and other plant O&M information.	1.WPCF Manual MOP 11(1977) entitled "Operation of Wastewater Treatment Plants" 2.Various manuals and texts on trickling filter O&M	1.Read the Manuals 2.Attend a short school if required.
B. Your knowledge of the safety in plant operations	1.WPCF Manual MOP 11(1977) entitled "Operation of Wastewater Treatment Plants"	1.Review materials
C. The location and description of the plant, names of key people at the plant	1.Atlas and city map 2.Plans of plant as built drawings if possible, from the city or the design engineer.	1.Review carefully trickling filter processes used
D. The specific type and size of equipment	1.Design engineer's specifications or city O&M manual. Copy in state pollution control office	1.Acquire from manufacturer the details of equipment in plant. Do not assume this will be at the plant.
E. Is the plant meeting EPA requirements for effluent?	1.NPDES form for plant. 2.State compliance report submitted usually on a monthly basis at the state pollution control office	1.Review at least 1 years date. Look for trends toward improved or inadequate plant effluent.

F. What safety problems have occured at the plant?	1.OSHA records 2.Workman's Compensation Records	1.May indicate a special area of concern.
G. Schedule time of plant visit with city manager and/or superintendent in advance	1.Call-then follow up with a letter. Allow approx. 1 month before the visit unless it is an emergency visit.	1.Substantial cleanup will perhaps occur before the visit. 2.Ask in letter of special problems with equipment or materials that you might furnish to "help the city".

STEP 2
TELL THE TRAINEES WHAT TO EXPECT

1. Briefly describe the plant size, equipment, special problems, and other information. Answer questions.

2. Explain the trainee form to be filled out by each trainee and returned at the end of the classroom follow-up section after the plant visit.

   Suggested form follows on next page.

TRAINEE PLANT EVALUATION FORM
Field Trip
Trickling Filter Wastewater Treatment Plant

Trainee Name_____ Instructor_____

Date_____ Plant Visited_____

Class_____ Area Served:_____sq.mi.

Plant Design Flow_____MGD _____pop.
Peak Flow_____MGD
Average Flow_____MGD Type of Collection System:

Lab Results:
BOD Sus.Solids Set.Solids Separate_____
Combined_____

_____ _____ _____ Influent

_____ _____ _____ Secondary

_____ _____ _____ Effluent

Type of Equipment in Treatment System (Describe):

Screening_____

Grit Removal_____

Pre-Aeration_____

Flow Meter_____

Pumping_____

Primary Treatment:

Type of Sedimentation Tank_____

Dimension of Each Tank (1)_____(2)_____(3)_____(4)_____

Capacity of each Tank_____Digester_____

Length of Weir_____

Secondary Treatment:

Trickling Filter Diameter_____Depth_____Capacity_____Area_____Vol._____

On reverse side, draw one line sketch of entire plant flows
(including sludge)

OTHER OBSERVATIONS

1. Condition of plant grounds 2. Color of media - dark green? 3. Do arms move at uniform rate? 4. Condition of receiving stream. 5. Maintenance and physical condition of filters. 6. Use of safety precautions - keep off filters.	
Trickling Filters-Common Deficiencies To Observe. 1. Solids and greast in effluent 2. Seal leakage 3. Clogged nozzles 4. Splash plate adjustment	
Records to Review 1. Flow records 2. Daily log, problems and maintenance 3. Test results - process controls 4. Test results - effluent 5. Pretreatment and industrial controls	

General Comments and Observations:

STEP 3

WHEN YOU ARRIVE AT THE PLANT

Introduce yourself and trainees to the chief operator and indicate that your visit is to perform an O & M visit, not inspection, and that you would need his help during the plant visit. Specifically that you are interested in the trickling filter components in the plant.

Encourage the chief operator to walk the trainees through the entire plant and encourage questions. If there was evidence of operational deficiencies not identified by the plant operator, the instructor should make a visual inspection of plant equipment. Is normal maintenance being performed? Is it operational now? Review plant records for equipment failures concerning the trickling filter operation. Also review lab data on the plant and bacteriological test data. Make notes for the class briefing. Allow time for questions/answers and student input. Thank the plant personnel and return to classroom with trainees.

STEP 4

DEBRIEFING THE VISIT

1) Answer questions of trainees about the "Trainee Plant Evaluation Form"

2) Allow the trainee to complete the work assignment over a 2 or 3 day period. Use the summary of this work as a review for Section B on intermediate level trickling filter operation.

END

Examination Questions
Basic Trickling Filters
Module 112DWW (11 hours)

Name_____ Date_____

1. List the three types of wastewater treatment plants.

   1._____

   2._____

   3._____

2. A term used in preference to ppm is_____.

3. Trickling filter sludge is often called_____.

4. _____treatment processes require oxygen to function properly.

5. The three items required for biological sewage treatment are:

   1._____

   2._____

   3._____

6. "Stable" sludge is sludge that_____

   _____.

7. An acceptable BOD/N/P ratio for biological treatment is_____.

8. "Air" is apx. _____% oxygen.

9. Three biological forms found in a trickling filter are:

   1._____

   2._____

   3._____

10. List the four component parts of a trickling filter:

    1._____

    2._____

    3._____

    4._____

11. A trickling filter converts _____ solid into _____ solids.

12. A trickling filter actually filters out solids thus giving excellent BOD removal. True ____ False___

13. A temperature difference of apx._____ is required to get air movement through the filter.

14. A red color or foam in the effluent from the primary settling tank would indicate _____ _____.

15. Oxygen solubility when dissolved in water _____ when the temperature rises and _____ when you are located in high altitudes.

16. The normal (expected) DO level for a trickling filter would depend almost entirely upon _____.

17. The "average" BOD of sewage coming to a trickling filter after primary treatment would be _____ mg/l.

18. If a plant receives 204 mg/l BOD_5 and discharges 20 mg/l BOD_5 what is the % removal?

_____

19. Normal trickling filter effluents would have _____ nitrate levels indicating a high degree of _____.

20. List three items included in those things limited as discharge into a trickling filter plant.

1. _____

2. _____

3. _____

21. What does a high COD/BOD ratio indicate in the influent of a trickling filter plant? _____ _____

22. "Septic" means _____
_____.

23. List three good housekeeping items in good trickling filter operations.

1._____

2._____

3._____

24. _____flies are a nuisance around trickling filters.

25. Mercury was often used in past years as a _____ in a trickling filter, but is no longer approved.

26. A green color on a trickling filter surface indicates _____
_____

27. List one maintenance technique used on a dosing tank for a trickling filter._____
_____
_____

28. Three areas of potential accidents (not gas related) in a trickling filter plant are:

1._____

2._____

3._____

29. Two gas related accidents in a trickling filter operation are:

1._____

2._____

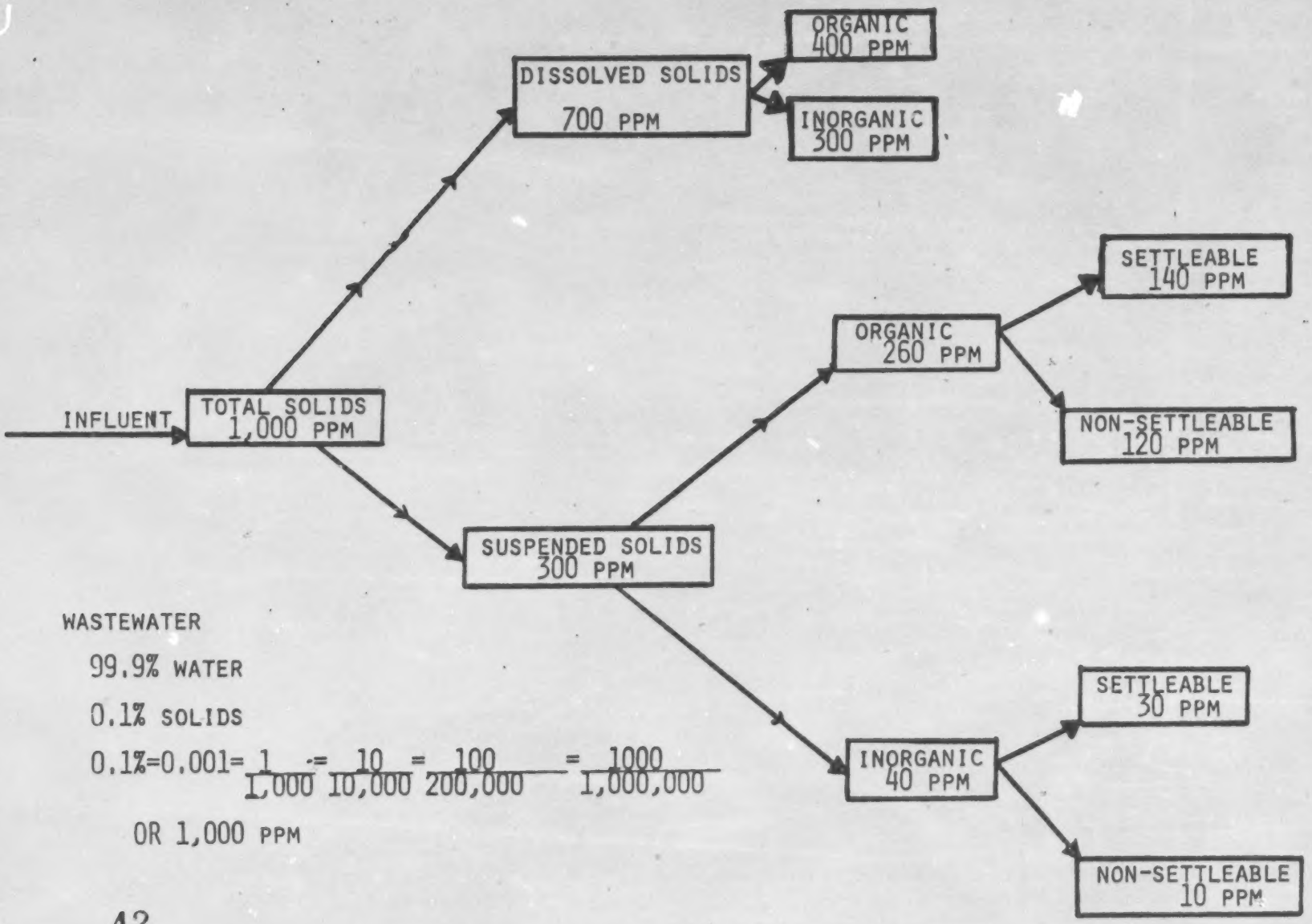
30. Before entering a trickling filter system to inspect it, you should:
_____
_____
_____

31. - 33. Sketch a "typical" trickling filter plant flow diagram.

SEWAGE TREATMENT

PRIMARY TREATMENT=	PHYSICAL TREATMENT (GRIT, SCUM, SLUDGE-OUT) SETTLING AND FLOATING
SECONDARY TREATMENT =	BIOLOGICAL TREATMENT (TRICKLING FILTERS OR ACTIVATED SLUDGE)
TERTIARY TREATMENT =	ANYTHING AFTER SECONDARY TREATMENT

SOLIDS OF A TYPICAL DOMESTIC WASTEWATER



WASTEWATER

99.9% WATER

0.1% SOLIDS

$0.1\% = 0.001 = \frac{1}{1{,}000} = \frac{10}{10{,}000} = \frac{100}{200{,}000} = \frac{1000}{1{,}000{,}000}$

OR 1,000 PPM

SLIDE 3

TRICKLING FILTER IS BIOLOGICAL TREATMENT,

SECONDARY TREATMENT.

CONVERT SUSPENDED, NON-SETTLEABLE AND

DISSOLVED SOLIDS TO SETTLEABLE SOLIDS.

SLIDE 4

TRICKLING FILTER SOLIDS CALLED "HUMUS" OR

SECONDARY SLUDGE MUST USE SECONDARY CLARIFIER

WITH TRICKLING FILTER.

SLIDE 5

AEROBIC PROCESS

(TRICKLING FILTER)

NEEDS

FOOD (SEWAGE)

OXYGEN (AIR)

"BUGS" (BACTERIA + OTHERS)

AEROBIC PROCESS

1 POUND SEWAGE (FOOD) C/N/P 100/2/1	+ 1 1/2 POUNDS D.O. (OXYGEN)	+ "BUGS" AEROBIC	PRODUCES	STABLE SLUDGE	+ $CO_2 + H_2O + SO_4^{=}$ $NO_3^{-} + PO_4^{\equiv}$

NO ODORS

7

ANAEROBIC PROCESS

SEWAGE (TOO MUCH) + DO (TOO LITTLE) + "BUGS" ANAEROBIC PRODUCE UNSTABLE SLUDGE + CH_4 + H_2S + NH_3 + PU

STRONG ODORS

SLIDE 8

TRICKLING FILTER NEEDS:

FOOD - BOD/N/P

100/2/1 RATIO

SLIDE 9

OXYGEN

(AIR = 20% O_2)

SLIDE 10

"BUGS"

1. AEROBIC, FACULTATIVE BACTERIA EAT SOLIDS
2. ALGAE (GREEN ON SURFACE)
3. FUNGI - FAVORED IF LOW DO AND LOW pH
4. PROTOZOANS - EAT BACTERIA
5. NEMATODES
6. SNAILS - EAT SLIME
7. FLY (PSYCHODA, OTHERS)

SLIDE 11

PRETREATMENT AND PRIMARY TREATMENT

KEYS TO TRICKLING FILTER PERFORMANCE

SLIDE 12

YOU SHOULD KNOW:

1. TYPES OF TREATMENT

   PRIMARY, SECONDARY, AND TERTIARY

2. SOLIDS IN WASTEWATER

3. PURPOSE OF TRICKLING FILTER

4. IMPORTANCE OF SECONDARY CLARIFIER

5. THREE ITEMS FOR AEROBIC PROCESS

   FOOD

   OXYGEN

   BUGS

SLIDE 13

YOU SHOULD ALSO KNOW:

1. AEROBIC SEWAGE TREATMENT PROCESS

2. ANAEROBIC SEWAGE TREATMENT PROCESS

3. TRICKLING FILTER NEEDS:
   BOD/N/P

   100/2/1

SLIDE 14

FOOD

OXYGEN

& BUGS

EFFECT

PERFORMANCE

SLIDE 15

SEWER

USE

ORDINANCE

SLIDE 16

Q U E S T I O N S

SLIDE 2-1

THE FOUR COMPONENT PARTS OF A TRICKLING FILTER ARE:

UNDERDRAIN

MEDIA

DISTRIBUTOR

RETAINING WALL

SLIDE 2-2

WHAT DOES EACH

PART DO?

UNDERDRAIN SYSTEM

SLIDE 2-3

TYPES

OF

UNDERDRAIN

SYSTEMS

BLOCKS

SLIDE 2-4

HOW

ABOUT

THE

MEDIA?

WHAT

TYPES

ARE

USED?

SLIDE 2-5

TYPES OF MEDIA:

STONE

BRICK

REDWOOD

PLASTIC

COCONUT SHELLS

OTHER

SLIDE 2-6

DISTRIBUTOR ARM AND INFLUENT STRUCTURE

COMPONENTS:

INFLUENT PIPE

DISTRIBUTOR BASE

ARMS

SPLASH PLATES

ARM CLEANOUT

LEVEL ADJUSTMENT

TURN BUCKLES

SLIDE 2-7

RETAINING

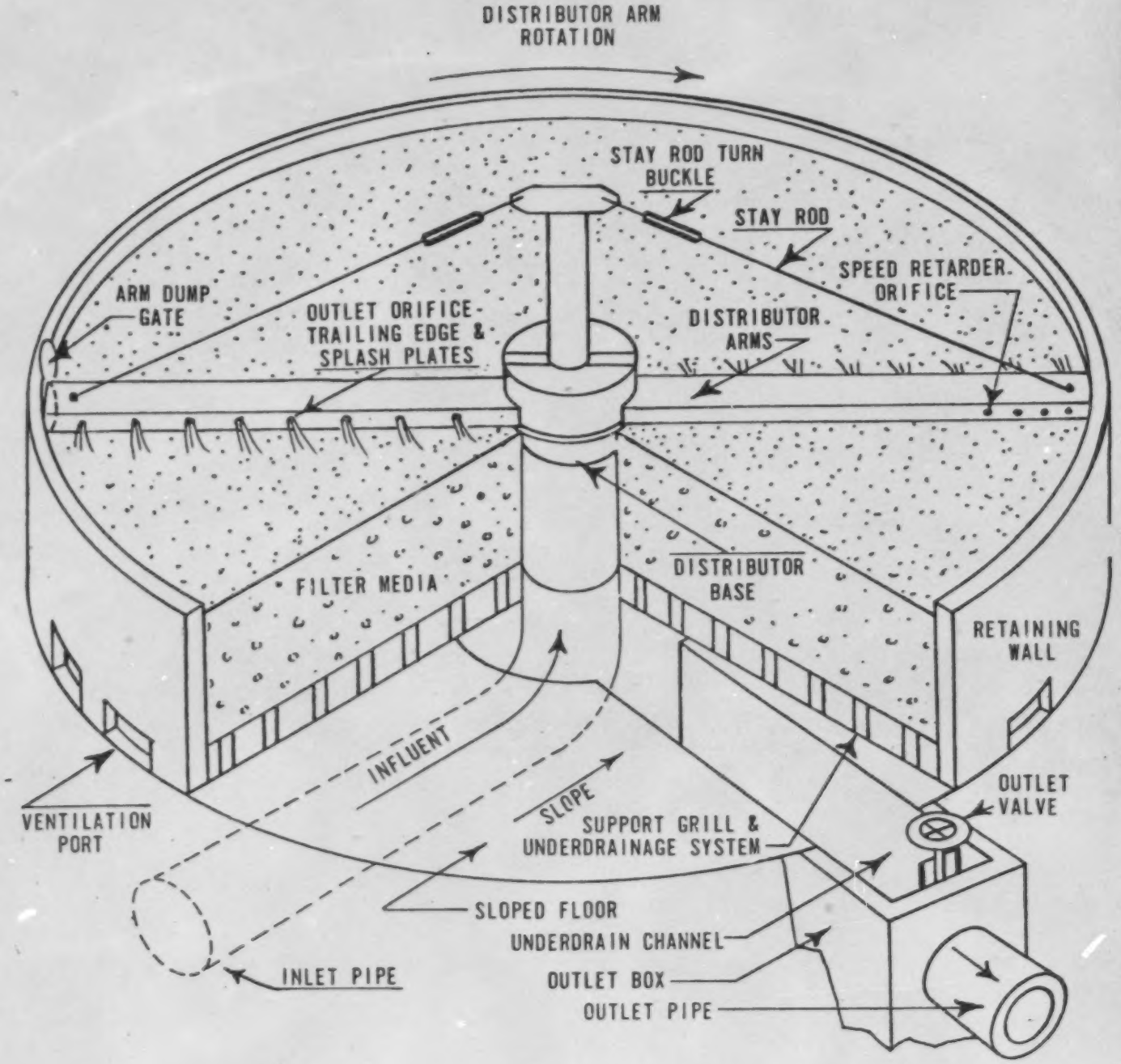
WALL

AND

VENT

PORTS

SLIDE 2-8


DISTRIBUTOR ARM ROTATION
STAY ROD TURN BUCKLE
STAY ROD
SPEED RETARDER ORIFICE
ARM DUMP GATE
OUTLET ORIFICE TRAILING EDGE & SPLASH PLATES
DISTRIBUTOR ARMS
FILTER MEDIA
DISTRIBUTOR BASE
RETAINING WALL
INFLUENT
SLOPE
VENTILATION PORT
OUTLET VALVE
SUPPORT GRILL & UNDERDRAINAGE SYSTEM
SLOPED FLOOR
UNDERDRAIN CHANNEL
INLET PIPE
OUTLET BOX
OUTLET PIPE

SLIDE 2-9

WHAT ARE THE FOUR

COMPONENT PARTS OF

THE TRICKLING FILTER?

LIST
THEM.

SLIDE_2-10

WHAT

ARE WE

TRYING

TO

ACCOMPLISH

WITH

THESE

FOUR

COMPONENTS?

SLIDE 2-11

CONVERT

DISSOLVED

AND

COLLOIDAL

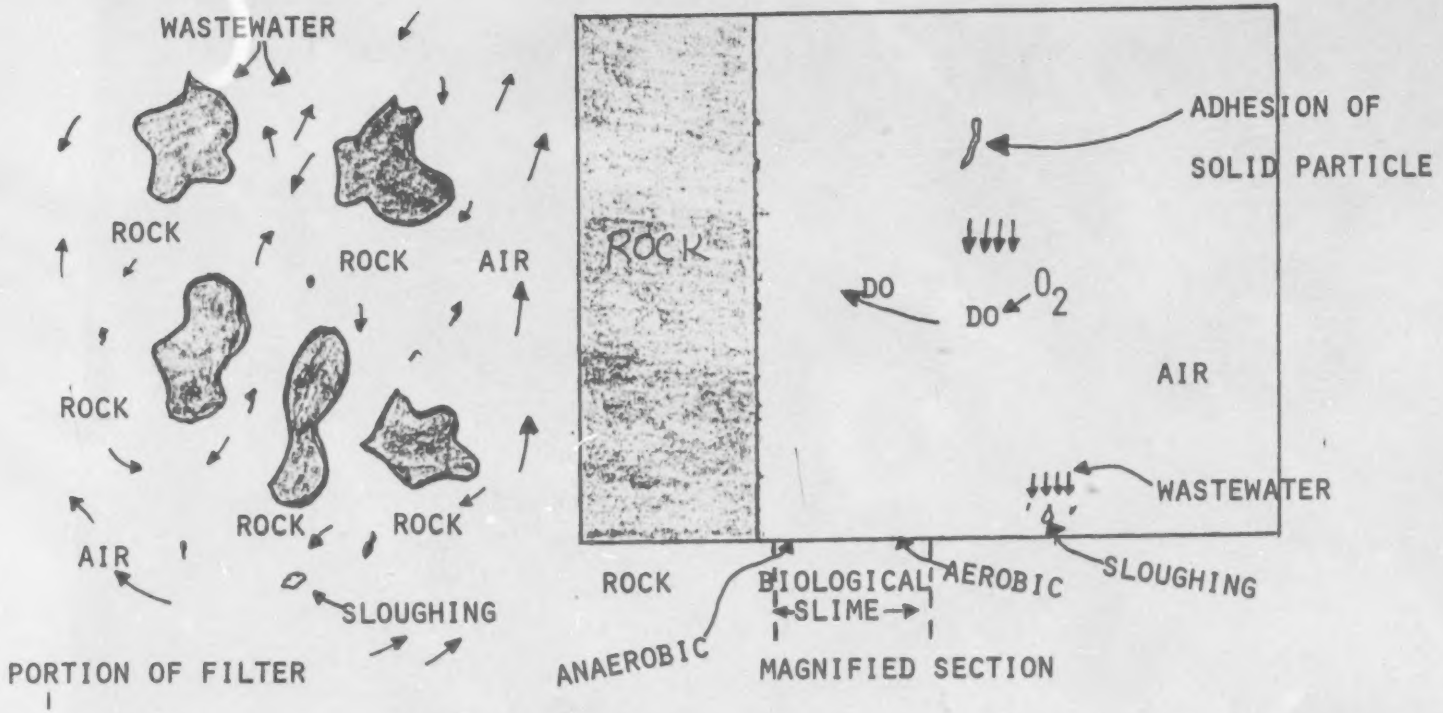
SOLIDS

TO

SETTLEABLE

SOLIDS

SLIDE 2-12. TRICKLING FILTER - BIOLOGICAL ACTION



SLIDE 2-13

TRICKLING

FILTER

NEEDS

FOOD (SEWAGE)

OXYGEN (AIR)

"BUGS"

SLIDE 2-14

DESCRIPTION OF SEWAGE

1. LITTLE ODOR
2. GRAY IN COLOR
3. SEWAGE SOLIDS SLIGHTLY DISINTEGRATED
4. DECOMPOSITION HAS BEGUN
5. DISSOLVED OXYGEN PRESENT
6. TEMPERATURE 40° TO 90° F.
7. CONTENTS

	PPM (MG/L)	POUNDS PER CAPITA PER DAY
SUSPENDED SOLIDS (TOTAL)	254	0.21
SUSPENDED SOLIDS (VOLATILE)	171	0.14
SETTLEABLE SOLIDS	200	0.17
BOD-5 DAY @ 20° C	204	.17
pH	7.3	
NITROGEN AS FREE AMMONIA	14	0.012
ORGANIC NITROGEN	22	0.018
BACTERIA	2,000,000 TO 20,000,000 PER ML	

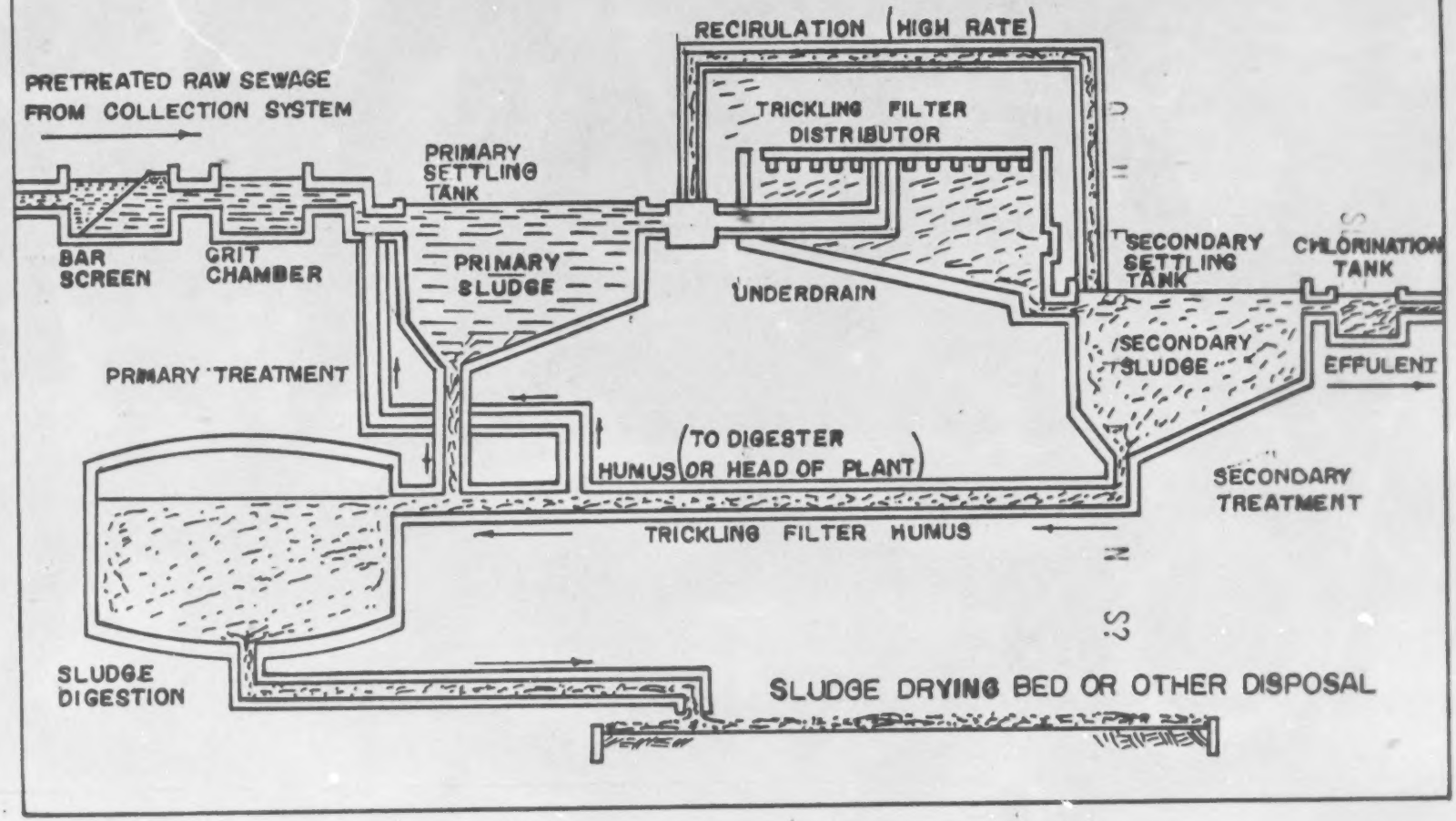
SLIDE 2-15

OXYGEN AND VENT SYSTEM

SLIDE 2-16

B U G S

SLIDE - 2-17
TYPICAL TRICKLING FILTER SEWAGE TREATMENT PLANT



SLIDE 3-1

OBJECT OF TRICKLING FILTER IS TO CONVERT SUSPENDED (NON-SETTLEABLE) AND DISSOLVED SOLIDS TO TRICKLING FILTER HUMUS (SETTLEABLE SOLIDS) CALLED SECONDARY SLUDGE

SLIDE 3-2

R E M E M B E R

FOOD

OXYGEN

BUGS

SLIDE 3-3

ALSO AEROBIC PROCESS - EFFLUENT

SATURATED WITH DO

SLIDE 3-4

TEMPERATURE

VS

SATURATION OF D.O. VALUES

SLIDE 3-5

WHAT WOULD BE THE EXPECTED OXYGEN (D.O.)

LEVEL OF A NORMAL TRICKLING FILTER

OPERATION (EFFLUENT)

SLIDE 3-6

RIGHT

SATURATION VALUE

SLIDE 3-7

WHAT FACTORS EFFECT SATURATION?

SLIDE 3-8

RIGHT.

1) TEMPERATURE

2) ALTITUDE

3) SALT CONCENTRATION

SLIDE 3-9

WHAT OTHER TWO THINGS WERE NEEDED FOR NORMAL FILTER

OPERATION.

SLIDE 3-10

RIGHT.

1) FOOD (SEWAGE)

2) BUGS

SLIDE 3-11

HOW ABOUT THE FOOD.

BOD/N/P

100/2/1

SLIDE 3-12

BOD MEANS - BIOCHEMICAL OXYGEN DEMAND -

5 DAYS AT 20^{o} C,

NORMAL VALUES - RAW SEWAGE 204 MG/L

TRICKLING FILTER EFFLUENT 30-40 MG/L

SLIDE 3-13

TRICKLING FILTER PLANT (PRIMARY UNITS PLUS TRICKLING

FILTER PLUS SECONDARY CLARIFIER)

INFLUENT 204 MG/L

EFFLUENT 30 MG/L

REMOVAL WAS:
204 - 30 = 174 MG/L BOD
(REMOVED AS SLUDGES)

SLIDE 3-14

HOW EFFICIENT IS THIS FILTER IN BOD (FOOD) REMOVAL

SLIDE 3-15

RIGHT 87%

OR

$$\frac{\text{IN-OUT}}{\text{IN}} \times 100 = \% \text{ REMOVAL}$$

OR

$$\frac{204 - 30}{204} \times 100 = 87\%$$

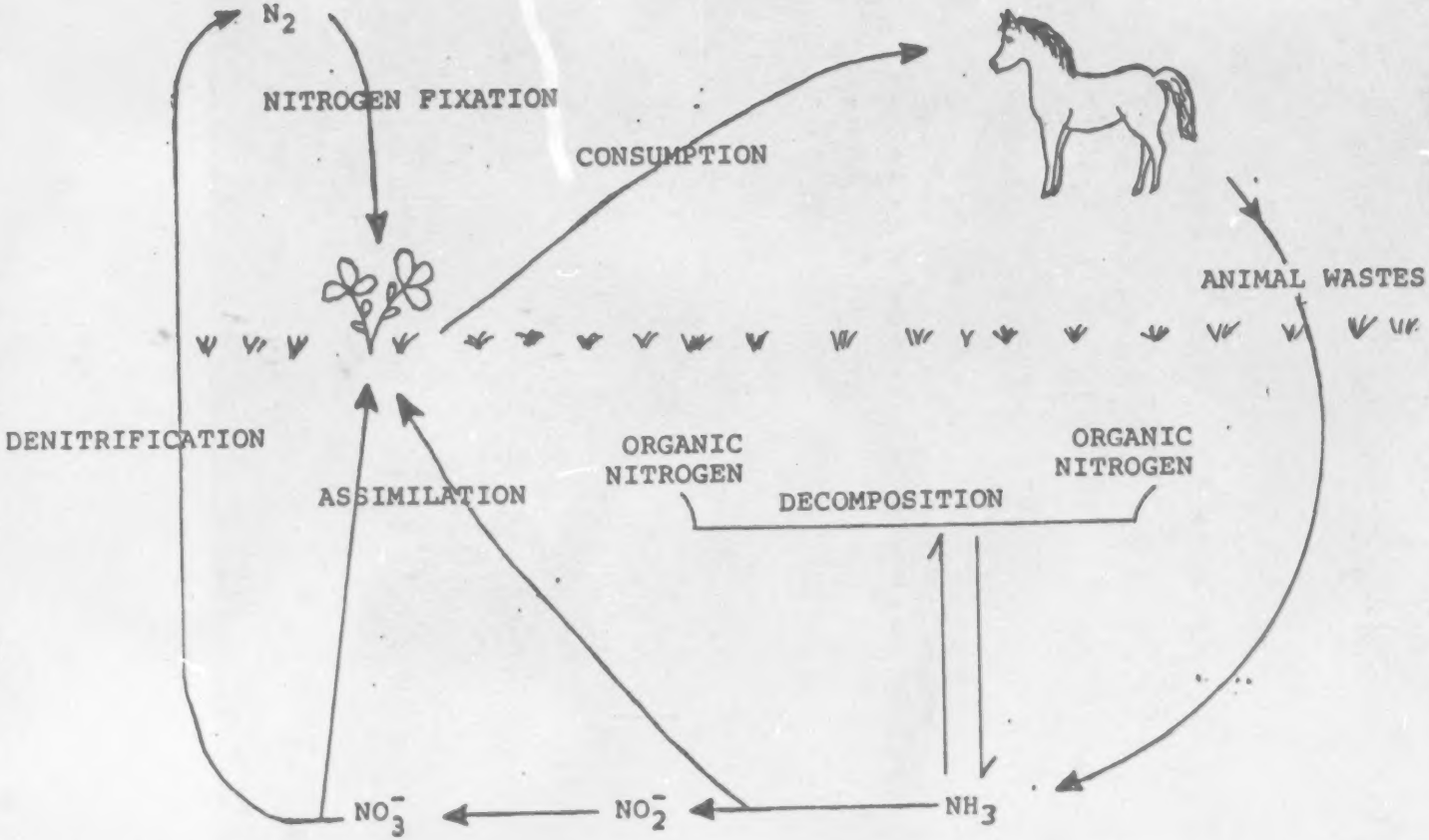


Fig. III-1. Nitrogen Cycle

SLIDE 3-17

WHAT SHOULD THE TRICKLING FILTER EFFLUENT CONTAIN?

AMMONIA OR NITRITE OR NITRATE

SLIDE 3-18

RIGHT.

NITRATE OR NO_3^-

SLIDE 3-19

HIGH NITRATES (EFFLUENT) INDICATE

GOOD PERFORMANCE

SLIDE 3-20

PHOSPHATES -

HIGH LEVEL ALSO $PO_4^{\equiv}$

SLIDE 3-21

SUMMARY

PURPOSES OF TRICKLING FILTER

1) SOLIDS CONVERSION - REMOVAL

2) SATURATED DISSOLVED OXYGEN

3) BOD REMOVAL

4) OXIDATION OF NITROGEN

5) PHOSPHATES IN EFFLUENT

SLIDE 4-1

TRICKLING FILTER OPERATIONS & MAINTENANCE (O & M)

SLIDE 4-2

AREAS OF TRICKLING FILTER O & M

1) Pretreatment
2) Primary Treatment
3) Grounds and Housekeeping
4) Trickling Filter Retaining Wall
5) Distributor Arms, Orfices, and Center Column
6) Media
7) Underdrain System
8) Dosing Tanks (where applicable)
9) Recirculation Pumps
10) Multi-Filter Operation

SLIDE 4-3

WHY CONSIDER PRETREATMENT AS A PART OF TRICKLING FILTER O & M?

SLIDE 4-4

EVERYTHING EFFECTS EVERYTHING - SEWER USE ORDINANCE

HIGH OR LOW pH

HIGH BOD/COD

HEAVY METALS

GREASE

OTHERS

KILL "BUGS"

SEPTIC FILTER

TOXIC LOADS

COAT MEDIA

SLIDE 4-5

PRIMARY TREATMENT - WHY IS IT IMPORTANT TO

TRICKLING FILTER PERFORMANCE?

SLIDE 4-6

POOR PRIMARY EFFLUENT	
SEPTIC (NO DO) EFFLUENT	CAUSE FILTER TO DECREASE REMOVAL
SOLIDS CARRY OVER (SLUDGE)	CLOG FILTER - DECREASE REMOVAL
GREASE CARRY OVER	CLOG FILTER - COAT STONES

SLIDE 4-7

WHAT ARE GOOD GROUNDS AND HOUSEKEEPING

PRACTICES?

SLIDE 4-8

RIGHT.

1) INSPECT FOR CRACKS, BREAKS, REPAIR AS NEEDED

2) REMOVE HIGH GRASS AND WEEDS NEARBY

3) REMOVE AND PREVENT ORGANIC GROWTH AND BLACK SLIME FROM INTERIOR WALL (ODORS)

4) IF STRUCTURE PAINTED OR COATED, REAPPLY AS NEEDED

5) OTHER?

SLIDE 4-9

O & M ON RETAINING WALLS?

SLIDE 4-10

RETAINING WALL O & M

1) INSPECT FOR CRACKS, BREAKS. REPAIR AS NEEDED

2) REMOVE HIGH GRASS AND WEEDS NEARBY

3) REMOVE AND PREVENT ORGANIC GROWTH AND BLACK SLIME FROM INTERIOR WALL (ODORS).

4) IF STRUCTURE PAINTED OR COATED, REAPPLY AS NEEDED.

5) OTHER?

SLIDE 4-11

O & M OF DISTRIBUTOR CENTER COLUMN, ARMS, AND ORFICES. WHAT TO DO.

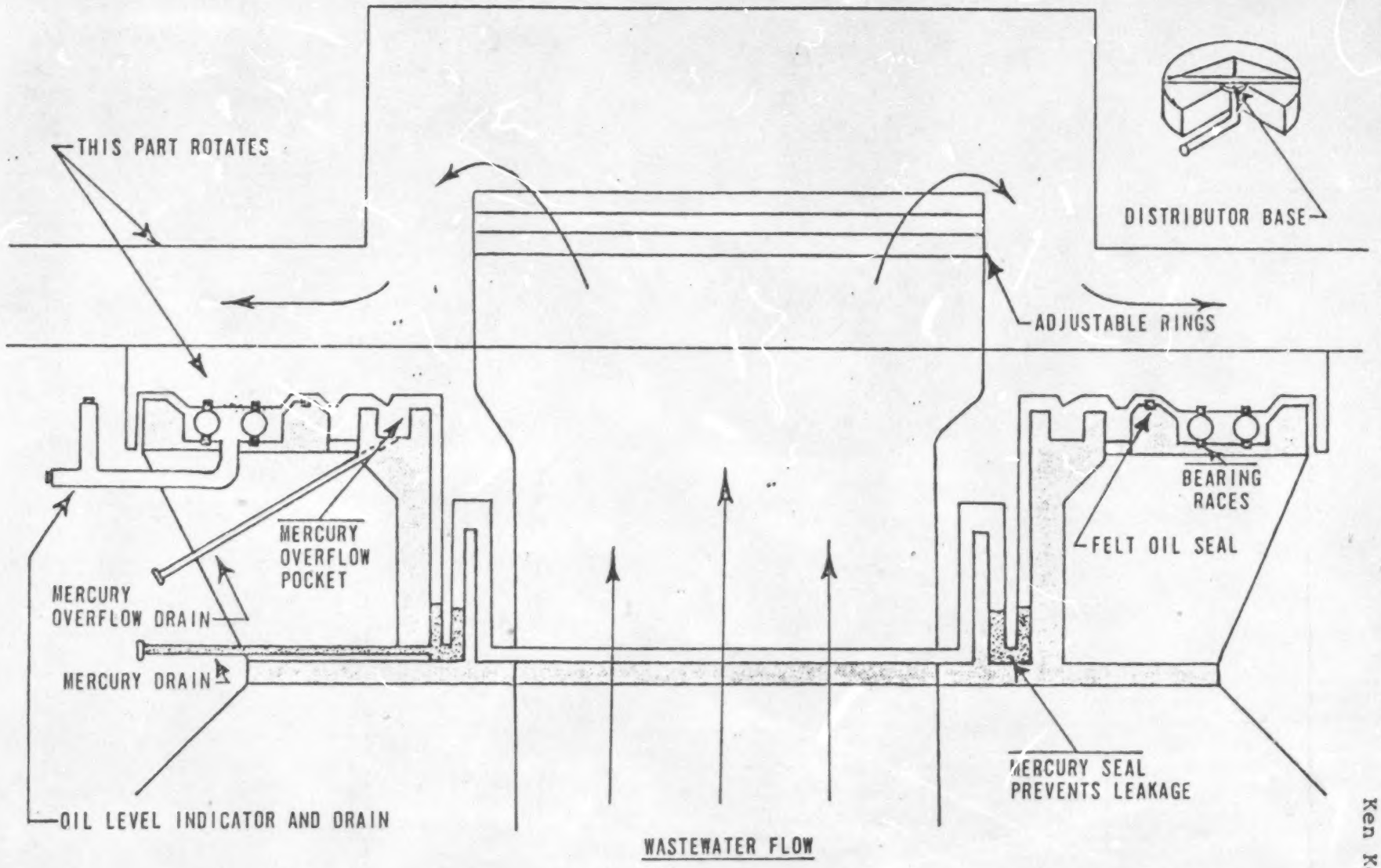
SLIDE 4-12

CENTER COLUMN O & M

1) MECHANICAL SEAL - INSPECT AND REPLACE FOLLOWING O & M MANUAL GUIDELINES

2) INSPECT OIL LEVEL FOR BEARINGS ON WEEKLY BASIS - CHANGE, FOLLOWING MANUFACTURERS SPECIFICATIONS

3) NO MERCURY SEALS...



SLIDE 4-13. MECHANICAL SEAL

SLIDE 4-14

DISTRIBUTOR ARMS O & M ?

SLIDE 4-15

O & M DISTRIBUTOR ARMS

1) INSPECT FOR CORROSION, PAINT FAILURE, RUST

2) ADJUST LEVEL OF ARMS USING SURVEYING TECHNIQUES FOR SUMMER vs WINTER OPERATION (TURN BUCKLES)

3) FLUSH WEEKLY - ROD IF NECESSARY

SLIDE 4-16

O & M DISTRIBUTOR ORFICES?

SLIDE 4-17

O & M DISTRIBUTOR ORFICES

1) KEEP CLEAN WITH WIRE BRUSH, DAILY IF NEEDED: REMEMBER SAFETY

2) CAN RUN "PAN TEST" TO SEE IF EQUAL FLOW PATTERN IS OBTAINED

3) COLD WEATHER ADJUSTMENT TO PREVENT FREEZING, DECREASE SPRAY PATTERN

4) INSPECT FOR SNAIL PROBLEM

SLIDE 4-13

O & M FOR MEDIA??

SLIDE 4-19

TRICKLING FILTER MEDIA O & M

INSPECT SEVERAL TIMES EACH DAY FOR:

COLOR - GREEN, HOW MUCH?

ODOR - NONE

INDUSTRIAL WASTES

PRIMARY TREATMENT SOLIDS

FILTER FLY PROBLEM

FILTER PONDING (POOLS OF WATER)

BLACK SLIME IN VOIDS

SNAIL PROBLEMS

GROWTH ON FILTER STONES (USE GLOVE) BIOLOGICAL FORMS (MICROSCOPE)

SLIDE 4-20

UNDER DRAIN O & M.

WHAT SHOULD YOU DO?

SLIDE 4-21

TRICKLING FILTER UNDER DRAIN VENT O & M

1) INSPECT WEEKLY:
   WATER LEVELS FOR CLOGGING

   LOOK FOR FINE SOLIDS FROM FILTER BREAKUP

   SNAIL CARCASSES

2) FLUSH OUT AS REQUIRED

3) CONTROL SNAIL CARCASSES

4) CLEAN AND REMOVE STOPPAGES

5) SAFETY SECTION MUST BE READ FIRST

SLIDE 4-22

TRICKLING FILTER DOSING TANKS O & M

WHERE USED?

SLIDE 4-23

TRICKLING FILTER DOSING TANKS O & M

1) USED WITH "OLDER" STANDARD RATE FILTER

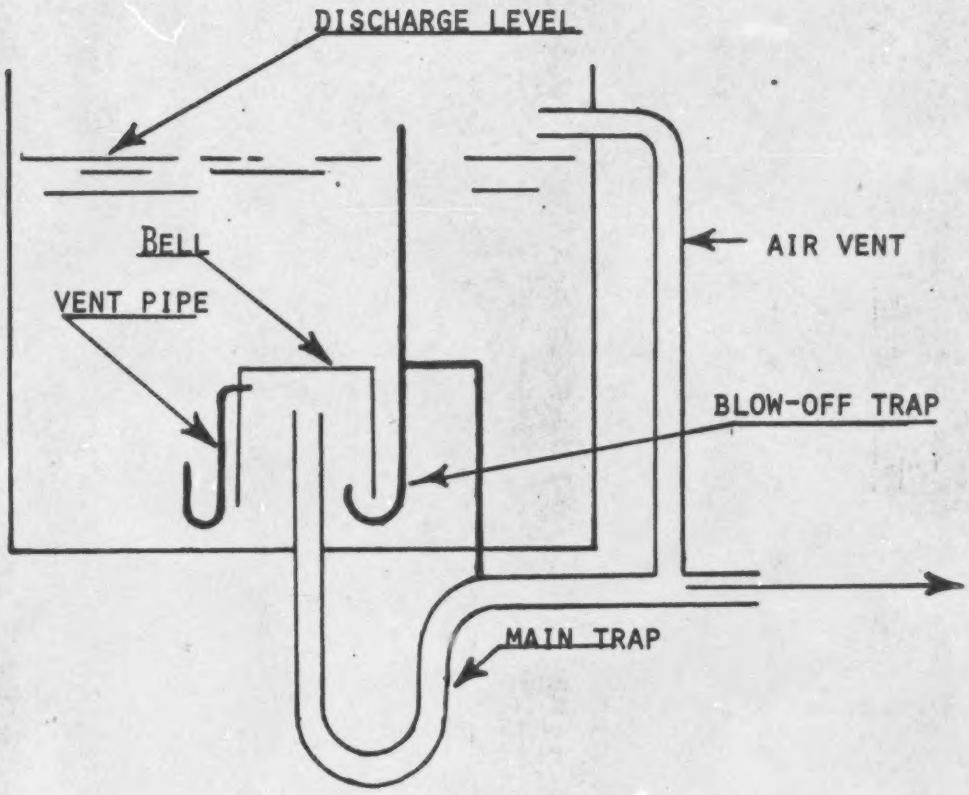
2) CHECK FOR LEAVES, GREASE, OR OTHER STOPPAGES

3) CHECK VENT - NO STOPPAGE

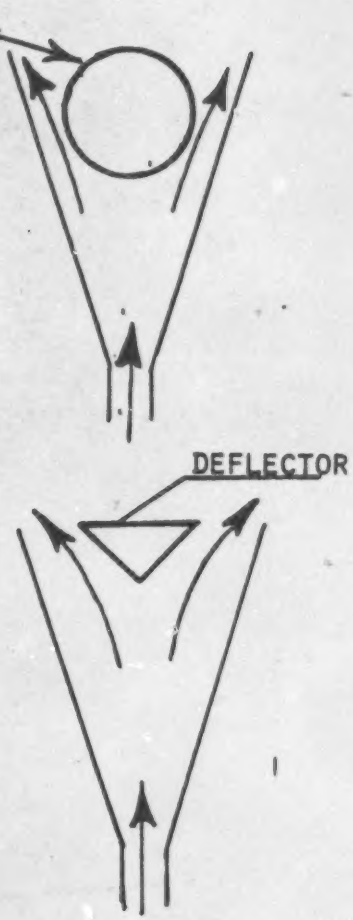
4) NO SOLIDS OR ODORS USE GOOD HOUSEKEEPING

SLIDE 4-24

DOSING SIPHON



AUTOMATIC SIPHON
OR DOSING CHAMBER



FIXED-SPRAY NOZZLES

SLIDE 4-25

O & M OF RECIRCULATION PUMPS

1) NORMAL PUMP O & M MANUFACTURER RECOMMENDATIONS

2) FLOW EQUALIZATION AND NO FLOODING

3) RECIRCULATION RATE vs BOD LOADING

SLIDE 4-26

MULTI - FILTER O & M

1) NORMAL FILTER O & M, AS ABOVE

2) PARALLEL vs SERIES OPERATION

3) FLOW EQUALIZATION

SLIDE 4-27

O & M RECORDS

LABORATORY CONTROL

SAFETY CONSIDERATIONS

SLIDE 4-28

QUESTIONS???

END

SLIDE 5-1

SAFETY IN

TRICKLING FILTERS

SLIDE 5-2

WASTEWATER OPERATIONS -- VERY DANGEROUS.

WPCF STATISTICS LIST WASTEWATER OPERATIONS

MANY TIMES MORE DANGEROUS THAN OTHER

OCCUPATIONS.

SLIDE 5-3

TRICKLING FILTER ACCIDENTS:

1) POOR HOUSEKEEPING

2) POOR PERSONAL HYGIENE

3) UNDERDRAIN AND VENTILATION WORK

4) CARELESS - GETTING ON FILTERS

SLIDE 5-4

ACCIDENTS AND

POOR HOUSEKEEPING

EXAMPLES

SLIDE 5-5

POOR HOUSEKEEPING

1) GREASE ON WALKWAYS - SLIPS AND FALLS

2) PILES OF DEBRIS - FALLS, CUTS, NAILS IN FEET

3) HIGH GRASS - SNAKES, ODORS, TURNED ANKLES

4) FILTER VENT GRATES - OPEN OR OFF - FALLS

SLIDE 5-6

ACCIDENTS AND POOR PERSONAL

HYGIENE, EXAMPLES?

SLIDE 5-7

DISEASE TRANSMISSION

SAMPLE COLLECTION

PICKING UP STONES

UNCLEAN CLOTHING

COOKING OR EATING NEAR PLANT

BITING FINGERNAILS

SLIDE 5-8

UNDERDRAIN AND VENTILATION ACCIDENTS -- WHAT ARE THEY?

SLIDE 5-9

RIGHT.

SUFFOCATION

AND

EXPLOSION

SLIDE 5-10

PREVENTION OF SUFFOCATION

1) TEST FOR OXYGEN DEFICIENCY AND GASES SUCH AS HYDROGEN SULFIDE AND METHANE.

2) ATTACH "APPROVED SAFETY HARDNESS" AND USE LIFE LINE BEFORE ENTERING VENT AREA.

3) FOR LONG JOBS, REPEAT GAS TEST ABOVE (1) OR USE SCOTT AIR OR OTHER SELF CONTAINED UNITS.

4) STATION 2 MEN AT ENTRANCE TO VENT SYSTEM TO HELP WITH LIFE LINE

SLIDE 5-11

PREVENTION OF EXPLOSION

1) TEST AREA FOR METHANE AND OTHER SUSPECTED GASES.

2) DO NOT ENTER UNSAFE AREA.

3) USE SAFETY EQUIPMENT ON LAST SLIDE

4) AVOID "SPARKING" TOOLS, LIGHTS, TORCHES, ETC.

5) WEAR NON-SPARKING (STATIC ELECTRICITY) SHOES, RUBBER PREFERRED

6) USE PROTECTIVE GLOVES, CLOTHING, AND EYE WEAR AS REQUIRED.

7) USE FORCED AIR VENTILATION WHERE REQUIRED.

SLIDE 5-12

CARELESSNESS

1) OPEN VENT COVERS

2) OPERATOR WALKING OR RUNNING ON FILTER SURFACE

3) HORSEPLAY

4) IF FILTER VALVE OFF OR STOPPED IN PLACE, TAG AND LOCK (IF POSSIBLE) WHILE WORKING ON FILTER - PUMPS INCLUDED.

SLIDE 5-13

SOLUTIONS TO TRICKLING FILTER SAFETY

1) INITIATE MANAGEMENT SAFETY PROGRAM

2) INITIATE OPERATOR SAFETY PROGRAM

3) FOLLOW GUIDELINES ABOVE

4) OSHA